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DO ARMORED SCALE INSECTS INFLUENCE VISIT RATE AND FEEDING ACTIVITY OF ANTS ON *ECHINOPSIS CHILENSIS*?[1]

RODRIGO RIOS-ARAMAYO[2] AND MILAGROS JIMÉNEZ[3]

ABSTRACT

The feeding activity of the ant *Camponotus hellmichi* was evaluated on *Echinopsis chilensis* Friedr. et Rowl. cacti. The mean number of ant visits was estimated on non-infested *E. chilensis*, on *E. chilensis* infested by the mistletoe *Tristerix aphyllus* Van Tiegh. Ex Barlow et Wiens, and on *E. chilensis* with *T. aphyllus* infested by the armored scale insect *Saissetia oleae*. Rate of ants visits to *E chilensis* with *T. aphyllus* infested by the armored scale insect (x = 15.3) was twice as much as the other to types of cacti (x = 7.6). Ants seem to forage for sugary secretions generated by armored scale insects, however ants do not tend armored scale insects and spend more time feeding on branches of *T. aphyllus* than on armored scale insects, possibly because most sugar secretions are left over *T. aphyllus*. We hypothesize that there are no mutual benefits between ants and armored scale insects and therefore it is an opportunistic interaction within *E. chilensis*.
Key words: Ant visits, sugary secretions, *Camponotus hellmichi*, *Echinopsis chilensis*, *Saissetia oleae*, *Tristerix aphyllus*.

RESUMEN

Se estudió la actividad alimenticia de la hormiga *Camponotus hellmichi* en el cactus *Echinopsis chilensis* Friedr. et Rowl. Se estimó la media del número de visitas de hormigas en *E. chilensis* sin infestacion, en *E. chilensis* infestados por el muérdago *Tristerix aphyllus* (Miers ex DC.) Van Tiegh. Ex Barlow et Wiens, y en *E. chilensis* con *T. aphyllus* infestados por la conchuela *Saissetia oleae*. Las hormigas visitaron *E. chilensis* con *T. aphyllus* infestados por la conchuela (x = 15.3) el doble de veces que los otros tipos de cactus (x = 7.6). Al parecer, las hormigas forrajean las secreciones generadas por las conchuelas; sin embargo, las hormigas no atienden a las conchuelas y pasan más tiempo alimentándose de las ramas de *T. aphyllus* que de las secreciones de las conchuelas probablemente debido a que la mayoría de las secreciones azucaradas son depositadas sobre *T. aphyllus*. Se sugiere que no existen beneficios mutuos entre hormigas y conchuelas, y que mas bien sería una interacción oportunista en *E. chilensis*.
Palabras claves: Visita de hormigas, Secreciones azucaradas, *Camponotus hellmichi*, *Echinopsis chilensis*, *Saissetia oleae*, *Tristerix aphyllus*.

INTRODUCTION

Mutually beneficial interactions between sap-sucking homopterans, such as armored scale insects and ants are well known (Price, 1997). Ants from the genus *Camponotus* include a diverse source of food in their diet, which can range from vertebrate excrement and insects, to plant material and sugary secretions (Hunt, 1973; Grez *et al.*, 1986). However, the use of sugary secretions and its influence over ant activity has been less studied.

Sugary secretions can be collected by ants as droplets directly from the armored scale insect *Saissetia oleae*. This insect must ingest much sap from its host in order to obtain its requirements of protein, minerals and vitamins. Much of this fluid bypasses the midgut of *S. oleae* by means of a filter chamber, and accumulates on its host or becomes

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[2] Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, Casilla 10077, La Paz, Bolivia, email: rodyand@ceibo.entelnet.bo, interacciones@hotmail.com.
[3] Instituto Regional de Ciencias Ambientales, Universidad Nacional San Agustín, Arequipa, Perú, email: milijimenez@yahoo.com, ireca@unsa.edu.pe.
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directly available to ants. *S. oleae* infests the endophytic mistletoe *Tristerix aphyllus* Van Tiegh. Ex Barlow et Wiens, a widespread and abundant parasite of the columnar cacti *Echinopsis chilensis* Friedr. et Rowl. Therefore, the presence of *T. aphyllus* and *S. oleae* could determine ant activity on *E. chilensis*.

The purpose of this study was to determine if the number of visits of the ant *Camponotus hellmichi* Menozzi to *E. chilensis* vary in relation to the presence of *T. aphyllus* and *S. oleae*, and to describe their feeding activity on individuals of *T. aphyllus* infested by *S. oleae*.

METHODS

Studies were carried out at the Río Clarillo National Reserve (33° 51´ S - 70° 29´W, 45 km southeast of Santiago, Chile). In order to determine the peak of ant activity on cacti during the day, the number of ants climbing up a pair of stems of two cacti were simultaneously evaluated during a 15 minute-period every 45 minutes. Data was recorded from 9:00 until 19:00 hours on December 6th 1999. Ants were collected to avoid counting them twice. At the beginning of each observation period, the ambient temperature was measured. A Spearman rank correlation was used to determine the degree of association between temperature and ant activity on cacti.

Influence of the presence of *T. aphyllus* and *S. oleae* on visit rate of ants to *E. chilensis* was examined by choosing 14 blocks of three cacti in an area of approximately 200 ha. Each block consisted of the following treatments: a) *E. chilensis* only, b) *E. chilensis* infested by *T. aphyllus*, and c) *E. chilensis* with *T. aphyllus* infested by *S.oleae*. Within each block, cacti were separated no more than 30m, to ensure that possible factors that could influence ant activity would be similar for all of the three treatments. Evaluations were performed only from 9.00 to 13:00 hours during the day and for no more than 45 minutes for each group. The 14 blocks were evaluated once within four days. On every cactus chosen, the number of ants going up four stems was determined during a 10 minute period. Ants were collected to avoid counting them twice. The number of flower buds and flowers was also recorded. A one-way ANOVA was used to examine the effects of cactus type on number of ant visits, and means were compared using Tukey multiple comparison test.

Ant behaviour was observed to determine preferences between sugar secretions from *S.oleae* and sugar secretions on *T. aphyllus*. Individual ants were observed for a 10 minute-period, registering the time they spent ingesting sugary secretions of *S.oleae*, sugary secretions on *T. aphyllus*, or feeding on other resources. Twenty different ants foraging in cactus with *T. aphyllus* infested by *S. oleae* were evaluated. A Kruskal-Wallis one-way ANOVA by ranks was used to examine the effects of food resource on the time spent ingesting sugary secretions. The time ants spent foraging on 27 individuals of *T. aphyllus* with different number of *S. oleae* was also evaluated, and a Spearman rank correlation was used to determine if foraging time varied with the density of *S. oleae*.

RESULTS

Ants showed two peaks of activity during the day (Fig. 1). The first began around 9:00 to 10:00 hours and dropped at 13:00 hours, while the second began around 16:00 to 17:00 and dropped at 19:00 hours. Activity was greater in the morning. Ants did not respond to changes in ambient temperature, as there was no association between the temperature registered and the number of ants visiting the cacti (r_s = -0.144; n = 28; P = 0.464).

The rate of ant visits varied according to the treatments ($F_{2,39}$ = 7.319; P = 0.02; n = 14). Ants visited cacti with *T. aphyllus* infested by *S. oleae* (x = 15.28, sd = 8.00, n = 14) almost twice as much as they visited cacti with only *T. aphyllus* (x = 8.57, sd = 4.78, n = 14) or with no *T. aphyllus* at all (x = 6.57, sd = 5.53, n = 14; Fig. 2); the latter two however did not differ (Tukey test, P = 0.68). The visit rate in *T. aphyllus* infested by *S. oleae* differed from the other two treatments: *E. chilensis* infested by *T. aphyllus*, and *E. chilensis* only (Tukey test, P = 0.002 and 0.021, respectively). The number of flowers on each cacti was used as a covariate for the one-way ANOVA since ants could be foraging in flowers for nectar or aphids, but no effect was found of this variable on the number of visits that ants made to each treatment ($F_{2,1}$ = 0.262, P = 0.612, n =42).

Feeding time spent by ants on the three different resources varied (H = 9.38, P = 0.009, n = 20).

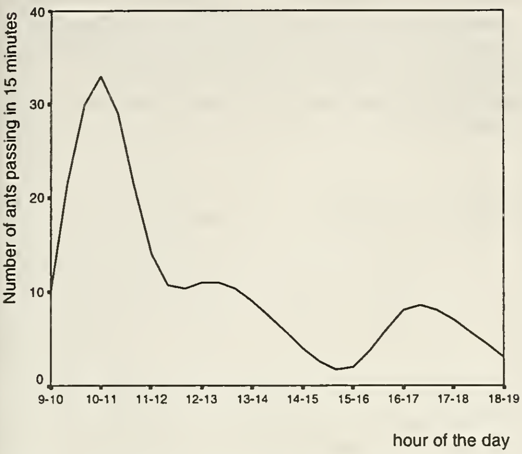

Figure 1. Number of ants visiting two individuals *of E. chilensis* during one day. Data was recorded on cacti with *T. aphyllus* infested by *S. oleae* on an average day. A greater peak of activity is found in the morning and a second, smaller, during the afternoon.

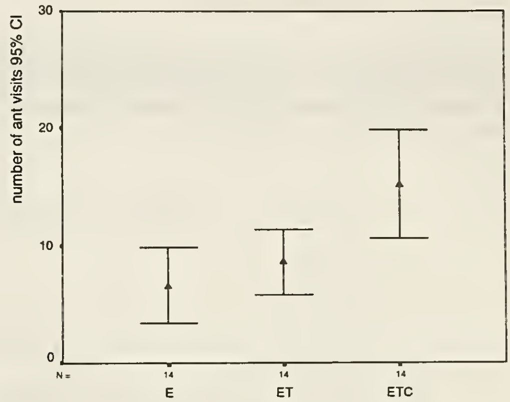

Figure 2. Mean and 95% confidence interval of the number of ant visits to *E. chilensis* alone (E), *E. chilensis* infested by *T. aphyllus* (ET) and to *E. chilensis* with *T. aphyllus* infested by *S. oleae* (ETC). Ants visit E and ET in lower numbers than they do ETC.

Ants spent more time feeding on honeydew found on branches of *T. aphyllus* (Me = 18.13, range = 65.13, n = 20) than the honeydew found on *S. oleae* (Me = 12.29, range = 42.33, n = 20) (Tukey analog, $P = 0.078$) or other resources such as aphids or fungi (Me = 0.00, range = 55.33, n = 20) (Tukey analog, $P = 0.071$). The foraging time spent by ants on individuals of *T. aphyllus* did not vary with the number of *S. oleae* found on them ($r_s = 0.24$, n = 20, $P = 0.236$).

DISCUSSION

Cacti with *T. aphyllus* infested by *S. oleae* received almost twice the rate of visits by *C. hellmichi* as the other sets of cacti evaluated. This pattern of ant activity on *E. chilensis* is probably due to the presence of *S. oleae* on *T. aphyllus*. However, within *E. chilensis* with *T. aphyllus* infested by *S. oleae* ants spend more time feeding on sugary secretions on *T. aphyllus* branches than on sugary secretions found on *S. oleae*. A reason for this might be that honeydew produced by *S. oleae* forms a sticky deposit on *T. aphyllus* branches and is eventually accumulated in greater quantities which are easily found by ants. Sugary secretions coming directly from *S. oleae*, even though ingested by ants, might however be less easy to encounter.

The presence of *T. aphyllus* on cacti does not seem to determine an increase in number of visits of ants on the populations of *E.chilensis*, even though sugary secretions can be found frequently in rotten fruits or dripping out of broken branches of *T. aphyllus*.

The relationship between coccids and ants differs from other interactions (i.e. between aphids and ants). No evidence such as ant patrolling or ant feeding was observed to suggest that ants tend *S. oleae* in order to obtain sugary secretions, a common activity, for example, in aphid-ant interactions. Hence, the relationship observed between *C. hellmichi* and *S. oleae* infesting *T. aphyllus* is not apparently mutualistic; rather, ants behave opportunistically, foraging on cacti in search of sugary secretions. This however does not discard the possibility that ants could also search for nectar and insects that are less common on cacti.

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